

1 APPARATUS AND METHOD FOR OPTIMALLY MIXING AND APPLYING A TWO  
2 PART EPOXY  
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4 This application claims priority of Provisional Patent Application #60/392,160, filed 6/28/2002.  
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7 BACKGROUND OF THE INVENTION  
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9 The present invention relates in general to an apparatus and method for mixing and injecting  
10 or applying an epoxy or viscous blend and more particularly to an apparatus which is capable of  
11 repeatedly mixing, delivering, and injecting or applying a preprogrammed amount of highly viscous  
12 two or more part epoxy which may contain strengthening or reinforcement fibers. The present  
13 invention represents a system for optimal delivery of the epoxy blend including heated holding tanks  
14 with auger feeds, a variable ratio pump capable of pumping highly viscous epoxy resin and hardener,  
15 and a unique dispensing and mixing head which is utilized as a part of the system. The apparatus is  
16 capable of mixing and delivering a preprogrammed quantity of epoxy mix in a very short period of  
17 time.

18 Epoxy is a common compound usually comprised of a hardener or curing agent and a resin  
19 which is often used as an adhesive and also to fill or seal gaps, holes, or cavities within a structure.  
20 Often, a fibrous reinforcing material is added to the blend to improve strength and durability. It has  
21 found wide use within the industrial, residential, and commercial sectors. One of the many industrial  
22 uses for epoxy includes the filling of holes or cavities in railroad ties and more particularly the filling  
23 of voids in railroad ties caused by rail seat abrasion. Rail seat abrasion represents an erosion or  
24 wearing of the railroad tie at the interface between the railroad rail and the tie. This phenomena is  
25 especially true for concrete railroad ties. That is, the movement of the railroad rail on the concrete  
26 tie during use causes a groove to wear into the tie. Stability of the rail necessitates repair of the  
27 groove by filling said groove with a strong and environmentally durable material. Typically, an epoxy  
28 and fiber mixture is placed into said groove and a rubber pad is placed between the rail and said epoxy  
29 mixture for complete repair and filling of said rail seat abrasion.

30 To date, large scale use of an epoxy resin as aforementioned has been difficult due to the  
31 highly viscous nature of said epoxy and the difficulty of feeding fibers with the epoxy. That is, a

1 highly viscous material is difficult to pump, feed, mix, and deliver in a short amount of time and  
2 further presents difficulties controlling the exact ratio of mixture delivered. Furthermore, when fibers  
3 are added to the epoxy mixture, traditional feeding, valving, and mixing mechanisms tend to fail when  
4 the fibers accumulate and jam around said mechanisms.

5       As intimated, epoxy is formed from a highly viscous epoxy resin and a hardener typically  
6 mixed in a ratio of 1:.5 to 1:2.0 respectively. Precise control of said mixing for such highly viscous  
7 materials is difficult due to unpredictable hose expansion and control of pump synchronization at the  
8 pressures necessary for delivery of the viscous epoxy. Prior to the art of the present invention, the  
9 mixing and delivering devices had a minimal amount of control over the quantity of resin and hardener  
10 delivered and were unreliable when fiber reinforcement material was added. With prior art devices,  
11 the user could not be assured that the same preprogrammed epoxy mixture amount could or would  
12 be delivered for every shot or use of the device. A further prior art problem is represented by the  
13 excessive amount of time which was necessary to deliver a preprogrammed amount of mixed epoxy.  
14 Ideally, the epoxy mixture should be delivered nearly instantaneously with the desired mixture of resin  
15 and hardener. Also, at the pressures necessary to flow such highly viscous materials, apparatus safety  
16 has continually been of concern.

17       The present art overcomes the aforementioned prior art limitations by providing an apparatus,  
18 system, and method for mixing, delivering, and injecting or applying a preprogrammed and repeatable  
19 amount of the aforementioned epoxy mixture in a short period of time from a dispensing or mixing  
20 head which delivers and mixes the epoxy. The present art utilizes uniquely heated storage and feed  
21 tanks for reducing the viscosity and improving cure time of the epoxy constituents and a unique  
22 variable ratio pump with spring loaded or biased suction and discharge port check valves to assure  
23 quick and repeatable delivery of the epoxy mixture. It further utilizes a unique combination of  
24 components which function reliably when a fiber reinforcement material is placed within said epoxy  
25 mixture.

26       Accordingly, it is an object of the present invention to provide a method, system, and  
27 apparatus for optimally mixing, injecting, or applying a two or more part epoxy which is capable of  
28 delivering a repeatable and programmed amount of epoxy into or onto a hole, cavity, or groove.

29       Another object of the present invention is to provide a method, system, and apparatus for

1 optimally mixing and injecting a two part epoxy which is capable of mobility on railroad tracks and  
2 on railroad ties when a rail has been removed.

3 A further object of the present invention is to provide a method, system, and device for  
4 optimally mixing and injecting or applying a two part epoxy which delivers the epoxy mixture quickly.

5 A still further object of the present invention is to provide a dispensing or mixing head as an  
6 integral part of the present art apparatus which provides the aforementioned advantages and is  
7 designed to work in conjunction with the present art apparatus.

8 A yet further object of the present invention is to provide a unique method of thinning and  
9 feeding the constituent parts of the epoxy blend through the use of uniformly heated tanks having  
10 auger feeds.

11 A further object of the present invention is to provide a variable ratio dual pump mechanism  
12 capable of continuous pumping action in both extension and reflex with unique spring loaded or  
13 biased check valves in the suction and discharge ports of said mechanism for precise mixture control.

14 A further object of the present invention is to provide a method, system, and apparatus for  
15 optimally mixing and injecting or applying a highly viscous material which may contain fibrous  
16 material in a safe and reliable manner.

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## 18 SUMMARY OF THE INVENTION

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20 To accomplish the foregoing and other objects of this invention there is provided an apparatus  
21 and method for optimally mixing and applying a two part epoxy. In its preferred embodiment, the  
22 system comprises two or more heated holding tanks having auger feeds, one or more variable ratio  
23 pumps which are fed from the tanks, one or more mixing heads, and a timer/air valve apparatus which  
24 triggers the feeding of the mixing head. Some of the components of the present system and apparatus  
25 are commercially available and uniquely combined in such a fashion as to deliver the results described  
26 herein. The dispensing or mixing head assembly, which is typically mounted onto a frame, is a non  
27 commercially available apparatus which is specially designed to achieve the results described herein.  
28 The variable ratio pump with its spring loaded or biased check valves is also specially designed to  
29 achieve the results described herein. The mixing head in combination with the variable ratio pump

1 and the heated auger feeding holding tanks, represent a unique and novel way of mixing and injecting  
2 a preprogrammed mixture of epoxy upon demand. The art of the present invention is uniquely  
3 capable of holding, feeding, and mixing an epoxy compound, including epoxy compound containing  
4 a fiber mixture for added strength.

5       The present art further incorporates a terrain drive on each side of the carriage, each having  
6 solid rubber tires. Each terrain drive may be lowered or raised via the action of a hydraulic cylinder.  
7 The terrain drives are driven by hydraulic motors and allow the carriage to be driven when the drives  
8 are lowered. The carriage further incorporates rail followers on each side of the carriage center axis  
9 which may be lowered onto a railroad rail and follow said rail when the terrain drives are moving the  
10 carriage. A unique feature of the present apparatus is the placement of a rail follower near the center  
11 axis of the machine whereby the carriage and apparatus may be guided by a railroad rail mounted on  
12 or near the center of the railroad track plane.

13       The art of the present invention may be manufactured from a variety of materials provided  
14 that said materials do not adversely react with the epoxy compounds or are properly coated to  
15 prevent such a reaction. Said materials include but are not limited to various metals and their alloys,  
16 woods, rubbers, plastics, or composites as required by the application. When disclosure of a  
17 commercially available component is satisfactorily described to those skilled in the art by block  
18 representation, said component along with its description, operation, and function shall be represented  
19 by a block within the drawings included herein or described in such terms as would allow one skilled  
20 in the art to practice the present invention. Those components which are not available as a  
21 commercial component and which are unique to the present art shall be presented in the drawings  
22 included herein.

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## 25                                   BRIEF DESCRIPTION OF THE DRAWINGS

26       Numerous other objects, features and advantages of the invention should now become  
27 apparent upon a reading of the following detailed description taken in conjunction with the  
28 accompanying drawings, in which:

29       FIG. 1 is a front perspective view of an apparatus for optimally mixing and applying a two

1 part epoxy mounted upon a carriage for transportation on railroad rails showing its unique method  
2 of use during a railroad tie filling application.

3        FIG. 2 is a front perspective view of an apparatus for optimally mixing and applying a two  
4 part epoxy showing the dispensing and mixing head assembly and applicator frame mounted upon a  
5 carriage for transportation on railroad rails.

6        FIG. 3 is a left side perspective view of an apparatus for optimally mixing and applying a two  
7 part epoxy showing two heated holding tanks, hydraulic components, on board generator, and  
8 carriage for transportation on railroad rails.

9        FIG. 4 is a right side perspective view of an apparatus for optimally mixing and applying a two  
10 part epoxy showing a heated holding tank, hydraulic components, on board generator, terrain drive  
11 and carriage for transportation on railroad rails.

12       FIG. 5 is a front perspective view of an apparatus for optimally mixing and applying a two  
13 part epoxy showing two heated holding tanks and epoxy pumps all mounted upon a carriage for  
14 transportation on railroad rails.

15       FIG. 6 is a top front perspective view of an apparatus for optimally mixing and applying a two  
16 part epoxy showing two heated holding tanks and epoxy hoses all mounted upon a carriage for  
17 transportation on railroad rails.

18       FIG. 7 is a top front perspective view of an apparatus for optimally mixing and applying a two  
19 part epoxy showing the pump mechanical linkage with a hinged plate having a groove or slot within  
20 said hinged plate with pinned or clevis type joints, a hydraulic drive cylinder on a first side of the  
21 hinge axis and two pumping pistons coupled onto the second side of the hinged axis, pump exiting  
22 hoses, limit switches triggered by the position of the hinged plate, pump/cylinder mounting bracket,  
23 and two heated holding tanks in the background.

24       FIG. 8 is a top front perspective view of an apparatus for optimally mixing and applying a two  
25 part epoxy showing the same components as described in FIG. 7.

26       FIG. 9 is a front perspective view of an apparatus for optimally mixing and applying a two  
27 part epoxy showing a hinged plate having a groove or slot within said hinged plate with pinned or  
28 clevis type joints, two pumping pistons coupled onto the second side of the hinged axis, pump exiting  
29 hoses, pump/cylinder mounting bracket, and a limit switch triggered by the position of the hinged

1 plate.

2        FIG. 10 is a left front perspective view of an apparatus for optimally mixing and applying a  
3 two part epoxy showing the mixing head frame with attached mixing head, handles, static mixer (far  
4 right), air spray hose and nozzle, timer trigger switch, air spray switch, epoxy feed hoses, mixing head  
5 pneumatic actuation cylinder, and electric pneumatic control valve. The topmost red switch controls  
6 the air discharge, the second to topmost red switch controls and activates the timer for epoxy mixture  
7 dispensing and the lower red switches control spontaneous forward and reverse direction drive on  
8 the terrain drives. The center toggle switch also provides continuous forward and reverse direction  
9 drive on the terrain drives when triggered.

10       FIG. 11 is an exploded view of one of one of the pistons/cylinder pumps showing the  
11 connecting rod, discharge port, connecting rod packing and sealing materials, cylinder and its wall,  
12 piston, piston ball check valve with added spring bias, piston packing and sealing materials, piston  
13 ball check valve seat, intake port ball check valve, intake port ball check valve spring bias, and the  
14 intake port.

15       FIG. 12 is an exploded view of the dispensing and mixing head showing the static mixer, the  
16 mixing block, seal plate, valving block, compound pin valves, O-rings, packing, valve actuating air  
17 cylinder, and associated connecting and mounting hardware.

18       FIG. 13 shows a cross sectional view of the of the valving block, seal plate, mixing block, and  
19 static mixer of the epoxy dispensing gun head taken along a mid section plane parallel with the front  
20 face having the two or more compound entrance holes.

21       FIG. 14 shows an exploded assembly front view of the dispensing and mixing head including  
22 the seal plate which fits between the valving block and the mixing block with internal passages shown  
23 in phantom. Said seal plate providing for placement and securing of the valve tip O-rings.

24       FIG. 15A shows a front view of the assembled dispensing head showing the separate epoxy  
25 feed ports and exiting holes and the adaptor for said static mixer with internal passages shown in  
26 phantom.

27       FIG. 15B shows a right side view of the assembled dispensing head showing the separate  
28 epoxy feed ports and exiting holes and the adaptor for said static mixer with internal passages shown  
29 in phantom.

1        FIG. 16 shows a perspective view of the assembled dispensing gun head showing the static  
2 mixer, the mixing block, the valving block, valve actuating air cylinder, and associated connecting and  
3 mounting hardware.

4        FIG. 17 is a top perspective view of the mixing head frame with attached mixing head, handle,  
5 air spray hose, timer trigger switch, air spray switch, epoxy feed hoses, and electric pneumatic control  
6 valve.

7        FIG. 18 is a perspective view of the hydraulic drive cylinder and its associated pivoting clevis  
8 and mounting hardware, showing the extension and reflux hydraulic fluid entrance/exit ports.

9        FIG. 19 is a perspective view of the pumps and associated mounting hardware, including  
10 piston coupling nuts, piston clevis, and pump rings. Said pump rings pivotably secure or cradle said  
11 pumps to a bracket which allows said pumps to pivot during operation.

12       FIG. 20 is a perspective view of the pump and hydraulic cylinder frame showing the support  
13 legs, pump/hydraulic cylinder mounting bracket also known as a support base, the hinged plate also  
14 known as wobble plate, along with the clevis and other mounting hardware.

15       FIG. 21 is a right side plan view of a heated holding tank having an auger feed and cavity  
16 shown in phantom and further showing the exiting port and heating element placement.

17       FIG. 22 is a schematic diagram of the hydraulic flow within the apparatus with attached  
18 descriptions of the numerically identified components.

19       FIG. 23 is a plan view of the hinged plate of Fig. 20 showing the hinge axis with a dashed line.

20       FIG. 24 is a plan view of the mounting bracket of Fig. 20.

21       FIG. 25 is a perspective view of the control panel for the apparatus.

22       FIG. 26 is a block diagram of the apparatus for optimally mixing and applying a two part  
23 epoxy.

24       FIG. 27 is an internal perspective view of a holding tank showing the auger feed, hydraulic  
25 motor housing, and exiting port.

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## DETAILED DESCRIPTION

29       Referring now to the drawings, there is shown in FIGS. 1-25 the apparatus for mixing and

1 injecting or applying an epoxy blend **10** which provides for optimum mixing and delivery of a two or  
2 more part epoxy or viscous blend. The apparatus **10** is particularly adapted for use within the railroad  
3 industry and especially on railroad tracks or railroad ties when a rail has been removed. The  
4 apparatus **10** provides a quick and consistent delivery of an epoxy mixture blend.

5       The drawings show the apparatus **10** first comprising, in a preferred embodiment, two or more  
6 holding tanks **12**. In a preferred embodiment, each holding tank **12** is used to hold either an epoxy  
7 resin or hardener. Typically the hardener is an amine curing agent material. In a preferred utilization  
8 of the present embodiments, the resin or hardener contains a plurality of fibers for added strength.  
9 More than two tanks **12** may be employed when the mixture requires more than two reactive agents  
10 without departing from the spirit or scope of the present art. The preferred embodiment incorporates  
11 a cavity **14** within the base and substantially surrounding each holding tank **12** into which is placed  
12 a heat transferring liquid **16** such as 50% ethylene glycol and 50% water mixture, or any other heat  
13 transferring liquid capable of heat transfer at the temperatures herein described. Heating elements  
14 **18**, preferably electrically actuated, such as industry standard firerods or other heating elements **18**  
15 are inserted into said heat transferring liquid **16** or placed onto the cavity **14**. As the liquid **16** heats,  
16 it uniformly transfers said heat to the resin or hardener, thereby reducing the viscosity of said  
17 materials. Without the heat transferring bath surrounding the resin, hot spots within the tank **12** tend  
18 to harden or scorch portions of the resin within the tank. An adjustable temperature sensor **20**  
19 monitors the liquid bath temperature and through the opening of relay contacts turns off the heating  
20 elements **18** when the resin or hardener reaches a desired temperature (typically 150° F) which is  
21 below the selfhardening temperature (typically 175° F). In addition to reducing viscosity, the heating  
22 action of the resin and hardener promotes the epoxy curing action when mixed. Alternative  
23 embodiments may forego incorporation of said heating elements **18** when the ambient conditions,  
24 compound reaction, and viscosity requirements allow.

25       Within the base of each holding tank **12** is an auger feeding system **22**. Each auger feed **22**  
26 helps to recirculate the resin or hardener within its respective tank **12** and also assures a positive  
27 material feed which prevents cavitation (gassing) within the fed viscous material due to unusually high  
28 vacuum or suction. Due to the high viscosity of the constituent epoxy parts, suction feeding solely  
29 from said tanks **12** is not practicable. Without utilization of the auger **22**, the unusually high suction



1 necessary for extraction of a high viscosity liquid causes the material to cavitate or “gas off” which  
2 will then create vapor pockets within the material suction line. Also, the suction necessary to remove  
3 the resin or hardener from each tank **12** could cause the connection hoses to collapse, thereby limiting  
4 flow. In the preferred embodiments, an auger **22** is placed at the base of each tank **12** and rotated,  
5 preferably with a hydraulic or other type of motor **24**, when the apparatus is operational. Each auger  
6 **22** feeds the exiting port **26** of each tank **12**. Thus, as the auger **22** rotates, the highly viscous resin  
7 or hardener is fed toward the exiting port **26** of its respective tank **12** and also thoroughly mixed. The  
8 auger system **22** functions much as an agricultural grain auger feeds grain but instead uniquely feeds  
9 the highly viscous resin or hardener to the exiting port **26** of each tank **12**, thereby reducing the  
10 suction head necessary to promote material flow. Although some of the aforementioned benefits may  
11 be achieved by pressurizing the holding tanks **12**, the pressure necessary for feeding such a highly  
12 viscous material, especially when contained in a large tank, is unnecessarily hazardous to the persons  
13 using the equipment and further represents an explosion risk. The mixing action of the auger system  
14 **22** further assures a uniform temperature distribution within the viscous materials.

15        Each of the compounds to be mixed exit their respective tanks **12** into a variable ratio pump  
16 **28**, typically through a hose which is not affected by the compound within. Each compound has its  
17 own pump **29**, yet each pump **29** is synchronously coupled to the other pump(s) **29** to ensure an exact  
18 mixture of each compound. That is, each pump **29** provides a flow rate of material which is an  
19 unchanging multiple or fraction of the other pump(s) **29** in order to assure proper ratio mixing. In  
20 a preferred embodiment, the synchronous coupling is typically achieved via a mechanical linkage **30**  
21 between two or more pistons which are capable of providing exiting pressure on both the up  
22 (extension) and down (reflex or retraction) stroke. Typically said linkage **30**/piston combination is  
23 actuated by a hydraulic cylinder drive **32** but may also be actuated by an electric motor, gear drive,  
24 or pneumatic means. Alternative embodiments may allow for said synchronous coupling through  
25 electronic control means. Said coupling ensures that the proper volume of each compound enters the  
26 mixing head at the same instant of time so that an exact mixing ratio is maintained.

27        The aforesaid pump mechanical linkage **30** is best described as a hinged plate **34** having a  
28 hydraulic drive cylinder **32** on a first side **36** of the hinge axis **38** and the pumping pistons coupled  
29 onto the other or second side **40** of the hinged axis **38**. In the preferred embodiment, the hydraulic

1 drive cylinder **32** is driven by a pressure controlled hydraulic pump. Said hydraulic drive cylinder **32** is pivotably secured to a bracket **42** and the extension rod **44** from said cylinder **32** is pivotably attached with a clevis **46** to said hinged plate **34**. The controlled hydraulic pressure of the hydraulic drive cylinder **32** limits the maximum pressure within the pumping pistons **29**. Within said second side **40** of the hinged plate **34** are two or more grooves or slots **48** into which pivotably mount the external ends **52** of the piston pump connecting rods **50**. The grooves **48** are preferably placed substantially perpendicular with the hinge axis **38** of the hinged plate **34** thereby allowing the connecting rod **50** external ends **52** to be slideably placed and secured at a desired distance from the hinged axis **38**. The closer a piston connecting rod **50** external end **52** is placed to the hinge axis **38**, the smaller the ratio of connecting rod **50** displacement to hydraulic drive cylinder **32** displacement. Thus if  $L_1$  represents the distance on the plate **34** from the hydraulic drive cylinder end **31** to the hinged axis **38**, and  $L_2$  represents the distance on the plate **34** from the first piston connecting rod **50** external end **52** to the hinged axis **38**, and  $d_1$  represents the linear displacement of the hydraulic drive cylinder **32**, and  $d_2$  represents the linear displacement of the first piston connecting rod **50**, then in equation form:

$$d_2 = \frac{d_1}{L_1} * L_2$$

For a second piston where  $L_3$  represents the distance on the plate **34** from the second piston connecting rod **50** external end **52** to the hinged axis **38** and  $d_3$  represents the linear displacement of the connecting rod **50** for the second piston, then in equation form:

$$d_3 = \frac{d_1}{L_1} * L_3$$

Thus, from the foregoing, it can be seen that the ratio of  $d_2/d_3$  is summarized as:

$$\frac{d_2}{d_3} = \frac{L_2}{L_3}$$

Since the volume of piston displacement is directly proportional to its connecting rod **50**

1 stroke linear displacement, for equal diameter piston/cylinder pumps, the material ratio mixture  
2 provided by two piston pumps **29** is simply the ratio of lengths at which each connecting rod **50** end  
3 **52** is secured from the hinge axis **38**, thereby providing the variable ratio pump **28**.

4        Each external end **52** of each connecting rod **50** is preferably mounted to each groove or slot  
5 **48** within said hinged plate **34** with a pinned or clevis **46** type joint. The pinned joint frictionally bolts  
6 within said groove **48** yet allows the connecting rod **50** end **52** to pivot on a pin mounted within said  
7 clevis **46** as the hinged plate **34** pivots on its hinged axis **38**. The cylinders **54** for each pump **29** are  
8 further mounted on a hinged cradle **56** comprised of a pump ring **58** attached to said cylinders **54** and  
9 pivotably secured to a mounting bracket **60**. This hinging allows the cylinders **54** to pivot as the angle  
10 of the connecting rods **50** change with the hinged plate **34** movement. The pivoting action or motion  
11 of the pump cylinders **54** further helps the highly viscous material to flow.

12        Limit switches **62** are mounted near the hinged plate **34** in order to control the movement of  
13 the hydraulic drive cylinder **54**. That is, when the pumps **29** or hydraulic drive cylinder **32** reach a  
14 maximum extension or reflex stroke, the hydraulic drive cylinder **32** movement must be reversed.  
15 Since the pumps **29** operate in both extension and reflex, reversal of the hydraulic drive cylinder **32**  
16 movement does not substantially affect the flow of the epoxy materials. The limit switches **62** are  
17 triggered by position of the hinged plate **34** and control an electric hydraulic valve which reverses the  
18 hydraulic pressure to the drive cylinder ports, thereby allowing the immediately prior drive port to  
19 drain into a hydraulic fluid reservoir and the newly or second pressurized drive port to supply  
20 pressure to drive the cylinder. Typically said limit switches **62** are electrical and control an electro-  
21 hydraulic valve, but alternative embodiments may utilize mechanical switches or valves which directly  
22 control the flow of the pressurized hydraulic fluid to said drive cylinder.

23        Although each pump **29** is a conventional piston and cylinder arrangement which is capable  
24 of positive pumping on both the extension and reflex stroke, typically a Graco model 1200 or model  
25 extreme, each is specially and uniquely modified with spring check valves **64**, **65** to prevent reflux into  
26 the storage tanks **12** and assure positive and metered discharge. Due to the viscosity and/or fibers  
27 of the epoxy resins, conventional check valves do not positively close on the extension or reflex pump  
28 cycle. This causes a reflux into the storage tanks **12**. When the check valves normally supplied with  
29 said Graco model 1200 are replaced with spring loaded check valves **64**, **65** of the present art, the

1 valve positively closes when required during the reflux and extension cycles. Alternative  
2 embodiments incorporate a hydraulically or pneumatically biased or controlled check valve.

3 As seen in Fig. 11, each pump 29 comprises a connecting rod 50 attached to a piston 66  
4 which operates within a cylinder 54. Each piston 66 has an included ball check valve 64 which is  
5 spring 68 biased or loaded onto a valve seat 70 which attaches with said piston 66. When the piston  
6 66 is forced into the cylinder 54 towards the intake port 72 the ball check valve 64 opens and allows  
7 viscous liquid material flow through said piston 66 and into the area within the cylinder 54 where the  
8 connecting rod 50 attaches with said piston 66. Since the volume displaced in front of the moving  
9 piston 66 is greater than that volume defined to the rear of the piston 66 due to the volume taken by  
10 the connecting rod 50, liquid material flows out of the discharge port 74 when the piston 66 is forced  
11 into the cylinder 54 towards the intake port 72. As the piston 66 retracts away from the intake port  
12 72 the piston check valve 64 stays closed, forces the liquid in the volume having the connecting rod  
13 50 out the discharge port 74, and further causes the spring loaded intake check valve 65 with spring  
14 67 bias to open and allow liquid material to enter the cylinder 54 from the intake port 72. The  
15 aforesaid, absent the spring bias/loading 67, 68 is typically found within a GRACO model 1200.  
16 Nevertheless, in order to function properly and assure positive check valve closure with a highly  
17 viscous liquid such as epoxy, the check valve springs 67, 68 must be added and are a unique part of  
18 the present invention. Prior art pumps such as the GRACO model 1200 have not solved the problem  
19 of check valve closure when pumping highly viscous liquids, especially when said liquids contain  
20 fibrous material.

21 Upon exiting from each pump 29, each epoxy constituent compound is fed into a separate  
22 "T" connection having an entrance and two exiting ports. A first exiting port of each "T" connection  
23 is connected with its own recirculating valve which allows recirculation into the respective holding  
24 tanks 12. The other "T" exiting port or second exiting port feeds the dispensing or mixing head 76  
25 through a hose which is not affected by the compound within. When the recirculating valve is closed,  
26 the dispensing or mixing head 76 is pressurized and ready for use. Pressure of said epoxy compounds  
27 is controlled by the hydraulic pressure supplied by the hydraulic drive cylinder 32. Said dispensing  
28 or mixing head 76 allows for each of said compounds, with or without added fibers, to enter said head  
29 76, thoroughly mix within a static mixer 78, and exit from said static mixer 78 nozzle into the groove,

1 cavity, or worn area of choice.

2       When actuation and use of the dispensing or mixing head **76** is desired, the aforesaid  
3 recirculation valves in the recirculation hoses are closed, thereby preventing recirculation into the  
4 holding tanks **12** and providing maximum compound pressure into the dispensing or mixing head **76**.  
5 Again, in a preferred embodiment, said pressure is controlled by the hydraulic pressure fed to the  
6 hydraulic drive cylinder **32**. Upon actuation of said dispensing or mixing head **76** for a  
7 preprogrammed user determined amount of time, each of said epoxy compounds which enter said  
8 dispensing or mixing head **76** is allowed to enter a static mixer chamber portion **80** of said mixing  
9 head **76** and thereafter be ejected through a commercially available static mixer **78** into the area or  
10 volume in which said epoxy is required. An air spray or nozzle **82** is typically provided near or on  
11 said mixing head **76** to clean the area onto which the epoxy is applied. In a preferred embodiment,  
12 said air spray is manually controlled with an electro-pneumatic valve, but alternative embodiments  
13 may incorporate automatic air spray systems prior to epoxy mix application.

14       Referring to Fig. 12 -16, the mixing head **76** assembly, also known as the epoxy dispensing  
15 gun head or dispensing head assembly, is comprised of two or more compound entrance holes **84** on  
16 the valving block **86** which feed through to two or more mixture exiting holes **88** on the mixing head  
17 **76** and which further feed the static mixer **78**. Said assembly is further comprised of two or more  
18 compound chambers **85** within the mixing head **76**, a mixing chamber **79** which is comprised of said  
19 static mixer **78**, a compound valve actuator **90**, typically an electrically controlled pneumatic cylinder,  
20 and two or more compound valves **92**, also typically known as needle or pin throttle valves slidably  
21 engaged and sealed within bores **91**. In the preferred embodiment, the static mixer **78** is placed over  
22 said mixture exiting holes **88** via the use of an adaptor **94** which allows the static mixer **78** to be  
23 threadedly engaged over said exiting holes **88**. Alternative embodiments may attach said static mixer  
24 **78** in any manner which allows epoxy components to flow and mix therethrough.

25       As further described herein, each component, chamber **85**, passage, or compound valve **92**  
26 is sealed with the necessary seals, gaskets, O-rings, or interface to prevent leakage or unintended  
27 mixing of the constituent epoxy compounds. In combination with such, each compound entrance hole  
28 **84** provides for the entrance of each constituent compound through the valving block **86** and into the  
29 mixing head **76** and also into its respective compound chamber **85** without leakage. If said compound

1 valves **92** are actuated by said valve actuator **90** when the recirculating valves are closed, each of said  
2 pressurized compounds are allowed to enter said mixing head **76** and each exit through its own  
3 mixture exiting hole **88** into said static mixer **78**. The static mixer **78** is available commercially and  
4 is typically comprised of a tube having an internal interrupted helix path of flow which provides for  
5 a turbulent mixing flow of said mixed compounds. Although a preferred mixing head **76** embodiment  
6 incorporates needle or pin type valves which allow compound flow into said mixing chamber **79**,  
7 alternative embodiments may incorporate other types of valves which when operated in synchronism  
8 or separately will allow compound flow into said mixing chamber **79** or static mixer **78**.

9        In a preferred embodiment, the tips of said needle or pin valves **92**, when closed, extend  
10 slightly into said compound chambers **85** in order to ensure that the bores **91** of said valves **92** remain  
11 clean and free from the materials within said mixing head **76**. Said preferred embodiment further seals  
12 the tips **93** of the needle valves **92** with O-rings **95** which are preferably manufactured of TEFLON  
13 or another material which is not affected by the epoxy compounds. Said O-ring **95** seal ensures that  
14 epoxy does not enter the needle valve **92** body and cause it to stick. Furthermore, although a  
15 preferred embodiment allows for the actuation of said valves **92** with an electrically controlled  
16 pneumatic cylinder as a valve actuator **90**, alternative embodiments may also provide for electric  
17 solenoidal, motor, or hydraulic control. The needle or pin type valves **92** of the aforementioned  
18 mixing head **76** provide reliable operation even if the epoxy mixture contains reinforcement fibers.

19        Figures 13, 14, and 15 show the respective cross sections of the valving block **86**, seal plate  
20 **96**, and mixing block **83**. The seal plate **96** fits and sandwiches between the valving block **86** and the  
21 mixing block **83** and provides the recesses necessary to hold and sandwich the aforementioned valving  
22 O-rings **95** in place. Alternative embodiments may utilize other forms for securing said O-rings **95**  
23 such as recesses in the valving block **86** or mixing block **83** and forego use of the seal plate **96**  
24 altogether. From the aforesaid figures, it is shown that each epoxy constituent compound enters the  
25 valving block **86** and flows through passages within the seal plate **96** into the mixing block **83** when  
26 said valves **92** are opened. Said compounds then exit through the static mixer adaptor **94** and into  
27 the static mixer **78** having the mixing chamber **80**, thereafter exiting onto the work surface as a mixed  
28 compound.

29        The timer of the present art, preferably electronic, allows for an electrical pulse of

1 preprogrammed pulsewidth to control the open and closed time of said valves **92** through said valve  
2 actuator **90** in order to provide a desired volume mix output. (For a preferred embodiment the timer  
3 is a model 365A manufactured by Automatic Timing & Controls of Lancaster, PA.) That is, if the  
4 pressure and flow rate is controlled by the synchronous pumps **28**, the amount of compound which  
5 is mixed and delivered through the static mixer **78** is simply a linear function of how long the  
6 compound valves **92** are left open. In a preferred embodiment said pulsewidth is programmable from  
7.1 to 3 seconds but may be configured for shorter or longer user desired pulsewidths. When the  
8 operator pushes a switch to energize said timer, the electrical pulse from said timer opens or energizes  
9 the electric valve which supplies pressurized air to the air cylinder to open the valves **92** in the  
10 dispensing gun head **76**. When said timer de-energizes or closes said electric valve, compressed air  
11 is transferred to the other side of said air cylinder to force said valves **92** into a closed position. In  
12 the preferred embodiment, any time that one side of the air cylinder is pressurized, said electric valve  
13 vents the other side to atmosphere. Those skilled in the art will appreciate that electrical timers are  
14 a staple item which are manufactured in many forms and use a variety of different technologies. The  
15 timer is commercially available and is claimed only in conjunction with the system described herein.

16       The valve actuator **90** is capable of providing positive force for opening and closing the  
17 compound valves **92**. When the valve actuator **90** is pneumatic, two air flow hoses are provided to  
18 the pneumatic cylinder, typically a pancake type cylinder, to provide positive and negative force and  
19 movement upon the compound valves **92**. The electric valve allows for one air flow hose to exhaust  
20 while the other hose is pressurized. Furthermore, in the preferred embodiment, the valve actuator  
21 **90** is spring loaded to provide a default closure of the compound valves **92** if necessary.

22       As aforesaid, the recirculation system typically comprises two or more hoses with inline valves  
23 which are attached with "T" fittings before the compound entrance holes **84** and feed unmixed  
24 compound back into the respective holding tanks **12**. Recirculation ensures temperature control and  
25 prevents separation of the constituent compounds. As aforesaid, each recirculation hose contains its  
26 own recirculation valve which is capable of regulating, controlling, and directing said recirculation  
27 flow. In a preferred embodiment, said valves are manually closed prior to actuating said mixing head  
28 **76** in order to apply full pressure to the mixing head **76**. Alternative embodiments incorporate  
29 recirculation valves which automatically close when said mixing head **76** is actuated.

1 In operation, the user places the exiting tube portion or open end **81** of the static mixer **78** into  
2 the area or volume which requires the epoxy mix. The user then, if desired, actuates the air spray **82**  
3 mounted near or on said mixing head **76** to clean the area onto which the epoxy is applied. When  
4 epoxy application is desired, the user triggers the timer via a switch. Upon triggering of the timer,  
5 an electrical pulse is created which actuates an electrically controlled pneumatic valve which allows  
6 compressed air to pressurize the compound valve **92** opening air line and exhausts to atmosphere the  
7 compound valve **92** closing air line. The compressed air thus supplied to the pneumatic valve  
8 actuator thereby opens the compound valves **92**. When open, the compound valves **92** allow a  
9 predetermined volume of each compound to enter the mixing chamber **79** or static mixer **78**. The  
10 compounds are then mixed within the static mixer **78** and mixing chamber **79** through the turbulent  
11 flow provided by said static mixer **78**. Thereafter, the mixed compound exits the open end **81** of the  
12 static mixer **78** as an epoxy mixture. When not injecting an epoxy mix, the recirculation valves are  
13 opened in order to provide compound recirculation for optimum temperature and viscosity control.

14 The present art further incorporates a terrain drive **98** on each side of the carriage **100**, each  
15 having solid rubber tires. Each terrain drive **98** may be lowered or raised via the action of a hydraulic  
16 cylinder **102**. The terrain drives **98** are typically driven by hydraulic motors, although alternative  
17 embodiments may utilize other types of motors, and allow the carriage **100** to be driven when the  
18 drives are lowered. The carriage **100** further incorporates rail followers **104** on each side of the  
19 carriage center axis which may be lowered onto a railroad rail and follow said rail when the terrain  
20 drives **98** are moving the carriage **100**. A unique feature of the present apparatus is the placement  
21 of a rail follower **104** near the center axis of the machine whereby the carriage **100** and apparatus **10**  
22 may be guided by a railroad rail mounted on or near the center of the railroad track plane.

23 From the foregoing description, those skilled in the art will appreciate that all objects of the  
24 present invention are realized. An apparatus and method for mixing and injecting or applying an  
25 epoxy blend has been shown and described. The apparatus provides quickly mixed, consistent, and  
26 convenient epoxy delivery, especially for railroad applications.

27 Having described the invention in detail, those skilled in the art will appreciate that  
28 modifications may be made of the invention without departing from its spirit. Therefore, it is not  
29 intended that the scope of the invention be limited to the specific embodiments illustrated and



1 described. Rather it is intended that the scope of this invention be determined by the appended claims  
2 and their equivalents.

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